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THE WORK OF THE SAN ANTONIO EXPERIMENT FARM IN 1918

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A Row Binder at Work Cutting Milo.

UNITED STATES DEPARTMENT OF AGRICULTURE
DEPARTMENT CIRCULAR 73

Contribution from the Bureau of Plant Industry
(Office of Western Irrigation Agriculture)

WM. A. TAYLOR, Chief

Washington, D. C. March, 1920

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

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AGRICULTURAL CONDITIONS IN THE REGION.

TREND OF AGRICULTURAL DEVELOPMENT.

The San Antonio region, as considered in this report, embraces an area extending southward and westward from the city of San Antonio, Tex., in which both crop production and live-stock raising are important. It is the area farthest west in the southern part of Texas where cotton production is important, and it also includes the eastern limit of live-stock production on the natural range in Texas. While much of the area is not susceptible of irrigation, there are some minor agricultural enterprises which are developed only where irrigation is possible. This is especially true of the Bermuda onion industry and other truck-crop enterprises. Some irrigated land is also devoted to the production of feed crops for sale. With a greater development of irrigation and the consequent production of forage crops, it is thought that a more rapid extension of the dairy industry will follow on the irrigated land. The water supply for irrigation is obtained both from underground supplies and from streams.

The agriculture of the region outside the small irrigated areas is characterized by two main agricultural enterprises, cotton growing and live-stock production. Of the cultivated area a very large proportion is devoted to cotton. Live-stock production is for the most part limited to the utilization of the natural range. The production of forage crops on the dry lands has not yet become an im-

portant feature. The protracted droughts which sometimes occur may affect the cotton crop adversely and almost certainly restrict the carrying capacity of the ranges. With a shortage of range feed, the cattleman must ship in feed, often at high prices, or dispose of a large proportion of his live stock, sometimes at a heavy loss because of their thin condition when marketed after a long dry season. In 1918 both the cotton farming and live-stock interests suffered, low cotton yields being general throughout the greater part of the area, and range conditions were poor, as a result of three successive dry seasons. Large numbers of cattle had been shipped out the preceding season, so that, even though range conditions were poor, the problems of the cattleman were probably less acute than

FIG. 1.—A plat of grain sorghum on the San Antonio Experiment Farm in 1918. This crop has been found to be the surest producer of grain feed for the San Antonio district and should be much more generally grown.

in the preceding season. The late fall and winter rains of 1918 benefited the range greatly and encouraged the growing of winter pasture crops, such as oats, wheat, and barley. The demand for feed was, therefore, less than during the winter of 1917, and the prices were much more reasonable.

The losses suffered by live stock during the last three years have resulted in an increased interest in the production of feed on the ranches. Some cattlemen are considering the desirability of constructing silos in which to store feed grown in the favorable seasons, to tide over the less favorable ones. Particular interest is manifested in the pit silo. Sorghum (fig. 1), which is the forage crop best adapted to the region, is therefore receiving particular attention from the live-stock men. Likewise, the high prices of feed

have stimulated among the cotton growers interest in greater diversification. There is a distinct tendency for the cotton farmers to make an effort to raise at least sufficient feed for the live stock necessarily kept on their farms.

TABLE I.—*Summary of meteorological observations made at the San Antonio Experiment Farm for the 12-year period from 1907 to 1918, inclusive.*

PRECIPITATION (INCHES).

Item.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average for 12 years, 1907 to 1918	0.68	1.62	1.38	3.46	3.06	1.28	1.71	1.80	2.41	2.92	2.44	1.85	24.63
For 1918	.04	1.72	.55	3.83	3.36	2.90	1.89	1.33	2.08	3.66	2.32	3.38	27.06

EVAPORATION (INCHES).

Average for 12 years, 1907 to 1918	2.69	3.18	4.76	5.71	6.71	8.64	9.67	9.10	7.06	5.20	3.17	2.47	68.36
For 1918	3.41	2.54	5.83	5.76	6.94	8.16	10.36	10.03	7.88	4.57	2.47	1.89	69.84

DAILY WIND VELOCITY (MILES PER HOUR).

Highest:													
1911 to 1918	10.7	15.9	11.9	10.6	10.2	11.9	12.5	12.6	10.1	8.5	11.0	8.6	15.9
For 1918	10.7	10.3	11.1	8.6	10.2	6.2	7.3	6.9	2.9	2.6	2.6	2.9	11.1
Lowest:													
1911 to 1918	.5	.1	.6	.3	.1	.5	.6	.5	.4	.3	.4	.3	.1
For 1918	.5	.9	1.3	1.9	.9	1.1	1.4	1.9	1.2	.6	.8	.7	.5
Mean:													
1911 to 1918	3.6	4.0	4.2	4.1	4.0	3.9	3.7	3.3	2.9	2.6	2.6	2.9	3.47
For 1918	3.8	4.2	3.9	4.6	5.0	3.4	3.5	3.9	3.5	2.2	3.0	3.0	3.67

TEMPERATURE (° F.).

Absolute maximum:													
1907 to 1918	88.5	93.0	95.5	102	103	108	108	107	104	98	90	85	108
For 1918	86	93	94	98	96	103	105	101	100	95	83	84	105
Absolute minimum:													
1907 to 1918	9	13	17	32	39	56	60	56	41	24	15	15	9
For 1918	9	24	38	41	51	67	65	70	48	39	27	27	9
Mean:													
1907 to 1918	52	54	63	68	75	83	85	84	79	69	60	51	68.6
For 1918	45	54	66	68	76	84	85	86	76	71	57	54	68.5

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		° F.		° F.	Days.
1907	Feb. 8	29	Nov. 12	32	277
1908	Feb. 20	24	Nov. 14	29	268
1909	Feb. 25	30	Dec. 6	31	284
1910	....do....	26	Oct. 29	32	246
1911	....do....	29	Nov. 13	31	261
1912	Feb. 27	30.5	Nov. 2	29.5	245
1913	Mar. 17	26.	Oct. 27	29	224
1914	Mar. 23	29.	Nov. 20	31	242
1915	Mar. 22	24.5	Nov. 15	27	238
1916	Feb. 20	32	Nov. 14	29	268
1917	Mar. 5	17	Oct. 29	24	238
1918	Feb. 21	32	Nov. 30	27	282

CLIMATIC CONDITIONS.

Weather conditions in 1918 were distinctly unfavorable from an agricultural standpoint. The lowest minimum temperature in the history of the experiment farm was recorded on January 11, 1918. The minimum temperature recorded at this time was 9° F. The cold spell was accompanied by about 2 inches of sleet and snow, rather unusual in the San Antonio district. The sleet and snow probably tended to lessen the effect of the cold on tender plants. A minimum temperature of 15° F. was recorded on December 8, 1917. The mean temperature for December, 1917, was 49° F., which was 2 degrees lower than the average for 12 years. The mean temperature for January, 1918, was 45° F., which was 7 degrees lower than the average for 12 years, while the mean temperature for February was 54°, which was the same as the average for 12 years. It will be seen that in general the winter of 1917–18 was appreciably colder than normal.

These different cold spells killed to the ground such subtropical fruits as oranges, pomegranates, figs, and olives. Even citranges were severely damaged by freezing. The Rusk citrange trees were the least damaged of any variety. Even these were frozen back somewhat, and the almost complete failure of the trees to produce in 1918 was attributed to the damage done by the cold. Canada field peas were killed out completely, and winter oats were damaged rather severely by frost on two occasions.

On the other hand, no late freezes occurred in the spring and a heavy crop of peaches and plums was set. Peach varieties, which seldom bear on account of damage by cold, produced a crop in 1918. The last killing frost in the spring occurred on February 21, and the first in the fall on November 30, making a frost-free period of 282 days for the season. While the total precipitation for the season of 1918 was somewhat higher than the average, the rain was so distributed as to be unfavorable for crop production. No precipitation of consequence came during November or December, 1917, or in January, 1918; consequently, there was no reserve moisture in the soil at the opening of the crop season. Light showers occurred during February and March, which made possible the seeding of most crops at about the usual time. The precipitation during April, May, June, and July was slightly more than the average, but it was not sufficient to overcome the drought of the previous winter. The precipitation during August and September was somewhat below normal, while for October, November, and December it was appreciably above normal. Moreover, the frequency of the showers during these months and the prevailing cloudy weather made conditions favorable for the absorption of a maximum quantity by

the soil. This also interfered somewhat with harvesting late crops and delayed land preparation for the succeeding year. These fall rains, however, came too late to benefit materially the crops of the current season, but made conditions favorable for seeding winter crops. The total precipitation for the season was 27.06 inches, as compared with 24.63 inches, the average for the 12-year period from 1907 to 1918, inclusive. The total evaporation from a free water surface was 69.84 inches. This was somewhat above the average of 68.36 inches for the 12-year period from 1907 to 1918, inclusive.

The meteorological observations at the experiment farm are made in cooperation with the Biophysical Laboratory of the Bureau of Plant Industry. Table I gives a summary of these observations for 1918, together with the means for the 12-year period from 1907 to 1918, inclusive.

CROP CONDITIONS.

Cotton is the principal crop of the San Antonio region; therefore the yield of the cotton crop is the measure often used to determine whether a season is relatively good or poor. Measured in this way the season of 1918 was an extremely poor one. The yield of cotton on the experiment farm in 1918 was the lowest ever recorded, the average on the rotation plats being at the rate of 258.6 pounds of seed cotton per acre. The yield was less than half of that obtained in any other season since the rotation experiments were started, even including the crop of 1917, when the total precipitation for the season was only 13.22 inches.

In this connection, Table II has been prepared, showing the production of cotton in equivalent 500-pound bales in a number of Texas counties in the San Antonio district for the 10-year period from 1909 to 1918, inclusive. The figures used in compiling the table are taken from the series of bulletins issued by the Bureau of the Census.[1]

Table II shows that the production of cotton in 1918 in Bexar County, in which the experiment farm is located, was not much more than half that of 1912, 1913, 1914, or 1916. In several other counties the production of cotton in 1918 was somewhat higher than in 1917, but in most instances much lower than in 1914, 1915, or 1916.

The yields of Indian corn and Dwarf milo on the experiment farm were somewhat larger than in 1916 or 1917, yet far from satisfactory. The yields of oats for both hay and grain were appreciably higher than in 1916 or 1917, but even then were very low. The more satisfactory showing of these crops was doubtless due to the showers which occurred during April and May, at a time when the crops were able to make the best use of the moisture.

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[1] Cotton production and distribution, 1909–1917/1918. [Titles vary.] U. S. Bureau of the Census, Buls. 107, 114, 116, 125, 131, 134, 135, 137. 1910–1918.

TABLE II.—*Cotton production in equivalent 500-pound bales in certain counties of southwestern Texas for the 10-year period from 1909 to 1918, inclusive.*

[Data from Bulletins 116, 134, and 137, Bureau of the Census, Department of Commerce.]

Counties.	1909	1910	1911	1912	1913	1914	1915	1916	1917	[1] 1918
Atascosa	4,297	6,179	9,436	14,798	11,392	14,366	8,736	11,076	5,929	9,256
Bandera	613	721	1,418	2,003	2,091	1,747	534	.....	.....	.....
Bexar	13,412	11,544	21,318	28,875	27,312	32,099	26,284	28,499	22,975	13,813
Comal	9,161	7,859	12,336	15,113	17,778	14,316	14,704	9,864	7,017	4,472
Frio	7,044	10,079	10,755	17,525	16,592	13,508	7,790	7,611	3,082	7,248
Guadalupe	33,813	25,122	39,732	51,516	58,953	45,813	46,941	48,352	27,277	15,985
Karnes	16,367	22,286	26,105	34,483	29,786	39,821	33,666	31,506	11,131	27,037
Kendall	1,564	1,513	1,659	2,496	2,709	3,431	1,504	740	406	451
La Salle	1,148	1,424	1,345	4,103	2,270	2,442	999	.....	.....	.....
Live Oak	.....	.....	.....	2,223	683	2,029	1,934	351	.....	1,932
Medina	8,163	11,925	10,874	18,933	13,468	16,661	5,751	9,259	4,931	5,146
Uvalde	3,107	3,546	4,503	9,871	6,889	7,777	1,709	3,575	.....	.....
Wilson	13,525	15,555	20,986	25,465	29,631	29,383	25,569	26,421	9,095	15,782

[1] Figures shown for 1918 represent the number of running bales, instead of equivalent 500-pound bales, and these data are taken from the preliminary report of cotton ginned made public by the Bureau of the Census on March 20, 1919.

FARM DEVELOPMENT.

On account of the scarcity and high price of labor, not much new agricultural development took place in 1918. Less than the usual area of land was cleared, and very few new farms were started. On the other hand, it appears that some farms were temporarily abandoned on account of the crop failures during the two years immediately preceding and the opportunities offered for earning good wages in war industries. It is to be noted that where land was left uncultivated it was usually in the newer sections where the settlers had not yet become well established, and in many instances it was where large tracts were controlled by single owners operated on the basis of share rental. With two successive crop failures many farmers were unable financially to stay another year, and share tenants did not care to take the chances on the uncertainties of another crop when labor was in such great demand elsewhere. Where owners were well established, they have been able to overcome the difficulties, and the favorable prices for cotton and other farm products have enabled them to stay on their farms.

SCOPE OF THE WORK OF THE EXPERIMENT FARM.[1]

The work of the San Antonio Experiment Farm consists mainly of field experiments designed to test crops and ascertain the best agricultural practices for this region. One of the most important lines of work includes crop-rotation and tillage experiments, which occupy approximately 28 acres of land, while other crop experiments

[1] The San Antonio Experiment Farm consists of about 125 acres of land situated 6 miles south of San Antonio, Tex. About 80 acres of the land is under cultivation. The farm is under the direction of the Office of Western Irrigation Agriculture of the Bureau of Plant Industry and is maintained from the funds of the Department of Agriculture.

occupy the remaining 50 acres which is under cultivation. From the rotation experiments it is expected to obtain data which will show the most profitable crop-rotation systems and the relation of crop sequence and tillage practices to the yields of the different crops.

Extensive cotton experiments are made in cooperation with the Office of Crop Acclimatization and Adaptation Investigations. This work is concerned with testing various methods of culture for the cotton crop and includes spacing and time-of-thinning experiments, the testing of cotton varieties, special studies on plant development, and the breeding and selection of improved varieties adapted to conditions peculiar to the San Antonio district.

Cooperation of the Office of Corn Investigations was had in testing corn varieties and methods of culture, with the Office of Cereal Investigations in flax experiments, and with the Office of Forage-Crop Investigations in testing sorghum varieties. Other offices cooperating in the work of the farm are Foreign Seed and Plant Introduction, Crop Physiology and Breeding Investigations, and the Biophysical Laboratory.

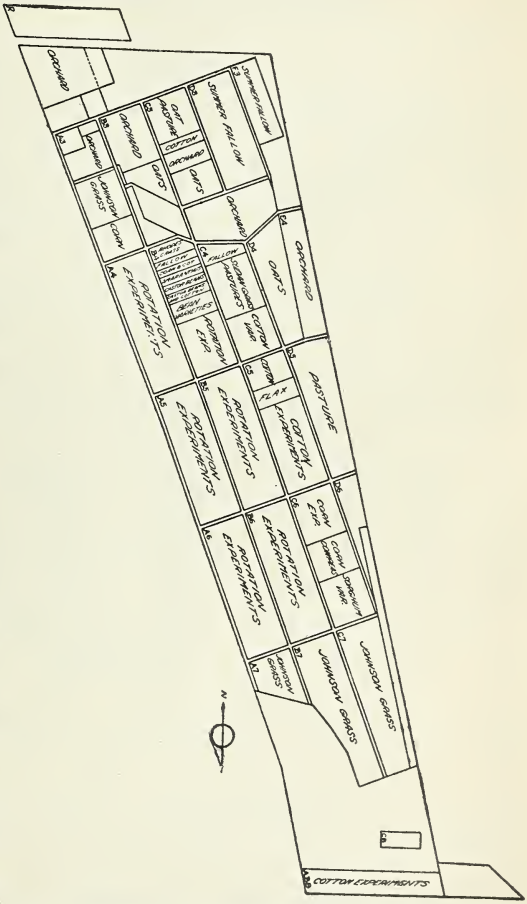

FIG. 2.—Diagram of the San Antonio Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1918.

The horticultural experiments, which have to do with the testing of fruit varieties, the testing of introduced fruits likely to be adapted to local conditions, and the testing of resistant stocks suitable for the soils and conditions of the district, are an important feature of the work. A large number of ornamental trees and shrubs, both native and introduced, are being grown about the farm buildings, in order to test their adaptability for the ornamentation of home grounds under the prevailing soil and climatic conditions.

Experiments in the utilization of winter oats and Sudan grass for pasturing cattle are being made. Attention is also given to the testing of new grasses and forage crops and other plants which have possibilities of being adapted to local conditions.

The arrangement of the fields and the location of the experiments in 1918 are shown in figure 2.

ROTATION AND TILLAGE EXPERIMENTS.[1]

The rotation and tillage experiments at the San Antonio experiment farm occupy 95 quarter-acre and 4 fifth-acre plats. The fifth-acre plats are used in an experiment in bordering to prevent run-off of the rainfall. Two of these bordered plats are used in a test of biennial cropping and fallowing with sorghum for forage. On the other two a rotation of corn and cotton is practiced. On the quarter-acre plats there are 21 two-year, 4 three-year, and 5 four-year rotations. In three of the two-year rotations the land is cropped biennially to corn, cotton, and oats and fallowed during the intervening period. Fifteen plats are cropped continuously to the same crops, continuous cropping being practiced with all crops grown in rotation except Sudan grass. Each year there are 30 plats of cotton, 21 of corn, 14 of milo, 16 of oats, 12 of sorghum, and 2 of Sudan grass.

The season of 1918 completed the tenth crop season for most of these experiments. A few of the rotations were started in 1913, so that from these the results of only six years are available. All crops planted in rows were cultivated as soon as possible after each rain that was sufficient to settle the soil mulch.

With the exception of cotton, the yields of all crops in the rotation experiments were somewhat higher in 1918 than in 1916 or 1917. Crops like oats, corn, and milo, which mature relatively early, made better yields because of the good rains of April and May. During this period of the preceding years the effective rainfall was appreciably less than in 1918. On most plats sorghum was able to survive, though it made very little growth during the summer drought. With later rains it was revived and made a fairly good growth. On plats where the sorghum was seeded in 8-inch drills on continuously cropped or late-plowed land practically all of the plants died from drought before the first cutting. With the early rains cotton grew vigorously. Probably because of this rank growth, it was more severely affected by the dry weather which followed and did not renew growth with the later rains. The result was the poorest cotton crop in the history of the experiments, the

[1] These experiments were under the immediate charge of Mr. A. A. Bryan, scientific assistant, who prepared the report here made.

average yield being less than half that of 1917 and less than half the average for 10 years.

While the precipitation for June was somewhat above normal, and it would appear that crops should not have suffered from lack of moisture, it was observed that these rains fell very rapidly at a time when the soil was dry and dusty so that a large proportion was lost through run-off. Morever, with clear, hot weather following immediately, much more was lost by evaporation. Since there was no reserve moisture supply in the soil, the crops were dependent entirely upon the current rainfall.

Table III shows the crops grown in the rotation experiments, the number of plats in each crop, the highest, lowest, and average yield per acre of each crop in 1918, and the average for the period during which the crop has been grown in the rotations. This period is from 1909 to 1918, inclusive, except where otherwise noted.

TABLE III.—*Yields per acre of crops in the rotation experiments on the San Antonio Experiment Farm in 1918 compared with average yields.*[a]

Crop.	Unit of yield.	Average yield.	Yield in 1918.			
			Number of plats.	Highest.	Lowest.	Average.
Corn	Bushel	21.7	21	31.2	10.1	17.9
Milo	do	[b] 28.3	14	35.2	11.2	21.3
Oats for grain	do	[c] 13.1	8	28.6	6.3	14.1
Oats for hay	Ton	1.51	8	1.95	1.33	1.69
Seed cotton	Pound	525.0	30	584.0	114.0	258.6
Sorghum, 4.1-foot drills	Ton	4.90	5	5.20	2.44	3.79
Sorghum, 8-inch drills	do	4.22	7	4.95	1.51	2.24
Sudan grass	do	[d] 5.07	2	5.09	2.7	3.9

[a] The average given is for the years during which the crop has been grown in the rotations, the 10-year period from 1909 to 1918, inclusive, except as otherwise noted.
[b] 1912 to 1918. [c] 1910 to 1918. [d] 1914 to 1918.

It will be seen that with the exception of oats for hay and for grain the 1918 yields of all crops were below the average for the 10-year period.

The results of these experiments are more valuable with the inclusion of those of each succeeding season. While definite conclusions can not be drawn with respect to every question that may be brought up in regard to the experiments, the results so far obtained very definitely indicate the advantage of some rotation system with all crops being grown.

The following specific results may be stated: Cotton in a 2-year rotation with corn yielded 390 pounds of seed cotton per acre in 1918, while under continuous cropping a yield of only 164 pounds was obtained. Another plat cropped continuously to cotton yielded only 128 pounds. A yield of 3.1 tons was obtained from sorghum in rotation with cotton, while sorghum under continuous cropping

yielded only 2.44 tons. Each year shows more forcibly the advantage of rotation in the control of certain weeds and plant diseases, particularly Johnson grass and cotton root-rot. On one plat continuously cropped to cotton 30 per cent of the plants were dead from root-rot at the end of the season. Not a single plant died on a nearby plat in a rotation of oats, cotton, and milo.

In regard to the time of preparation, the results in 1918 were similar in their indications to those of 1916 and 1917; that is, they showed as a rule that early preparation of the land was an advantage during periods of drought. Corn following oats on land plowed in November yielded 11.8 bushels per acre, while corn in a similar rotation but on land plowed in June soon after oat harvest yielded 28.5 bushels. These plats are close together and very similar in all respects. Cotton following corn on land plowed in August yielded 290 pounds of seed cotton per acre, while cotton in a similar rotation but on land plowed in February yielded only 254 pounds. Sorghum on corn land plowed in August yielded nearly twice as much as sorghum on cotton land plowed in November. Besides the advantage in case of drought, early preparation helps to distribute more evenly the use of labor throughout the year. It checks the growth of weeds, which would use up moisture and increase the cost of cultivation of the crops. A smoother and firmer seed bed resulting in quicker and more uniform germination is also more easily obtained with early preparation.

EFFECT OF DIFFERENT TILLAGE PRACTICES.

The results bearing on certain tillage practices are sufficiently definite to make a summary of them of practical value. These results will be considered under the following headings: Subsoiling, manuring, green-manure crops, biennial cropping, and the effect of rotation and tillage on root-rot in cotton.

SUBSOILING.

The results of subsoiling in 1918 varied in no important respects from those of previous years. The results of this practice for the years 1910, 1911, and 1912 were published in February, 1913.[1]

The effect of subsoiling may be seen from a comparison of the yields from five rotations where subsoiling is practiced with those from five other rotations exactly similar except that subsoiling is not a part of the practice. In the same way, four comparisons are possible showing the effect on corn, one each on oats for hay and for grain, and one over a period of six years showing the effect on Dwarf milo.

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[1] Hastings, S. H., and Letteer, C. R. Experiments in subsoiling at San Antonio. *In* U. S. Dept. Agr., Bur. Plant Indus. Cir. 114, pp. 9–14. 1913.

The average yield of cotton on subsoiled land was slightly less than on land not subsoiled. The same was also true of corn. Oats for hay and for grain and Dwarf milo yielded slightly more on subsoiled land. When average yields for the period since the rotations were begun are considered, all crops except oats for grain show a slight decrease on subsoiled land. The difference either way has usually been insignificant and decreases from subsoiling have been recorded about as often as increases. It appears, therefore, that subsoiling in the San Antonio region is merely an added expense and is not justified as a regular farm practice.

EFFECT OF MANURING.

When the rotation and tillage experiments were started it was expected that manure would add fertility, improve the physical condition of the soil, and increase its water-holding capacity. Several rotations, therefore, have been carried on where crops on manured land may be compared with crops on land not manured. Five such comparisons are possible with cotton, two with corn, three with milo, and one each with oats for grain and for hay. Most of these rotations are comparable over a period of nine years. One with cotton and one with milo are comparable for only six years.

The manure used has been produced by horses, mules, and cows, usually in open lots. Some of it contains more or less straw, while some has practically none. Its fertilizing value, therefore, is rather variable. Applications of manure have been made at the rate of 16 tons per acre.

Comparatively large increases in the yields of cotton, corn, and milo were obtained in 1918 as a result of the use of manure. The yields of cotton were nearly 44 per cent greater in manured rotations than in similar rotations where the cotton was not manured. The yields of corn were nearly 46 per cent greater in manured rotations than in similar rotations not manured. Milo yielded nearly 42 per cent more in manured rotations than in similar rotations not manured. The yields of cotton, corn and milo from manured rotations were more than 20 per cent above the general average for all plats of each crop. The effect of manure on oats has usually been adverse. In 1918 the grain yield was slightly less and the hay yield somewhat more where manure was used.

Increases in yields from the use of manure have usually been greater on land cropped continuously than where rotation is practiced. In 1918 the cotton yield under continuous cropping was more than doubled, and the corn and milo yields increased about 75 per cent.

The increases in yield obtained this year from the use of manure were important. When the average results for the 9-year period from 1910 to 1918 are considered, however, the results have not justified the expense, especially when it is necessary to pay for the manure and haul it a considerable distance. On the other hand, it is believed that the results do justify the careful handling of manure produced on the farm and its application to land which is to be used for certain crops, especially cotton, corn, and milo.

GREEN-MANURE CROPS.

Canada field peas, cowpeas, and rye have been used as green-manure crops. The field peas were practically killed out by freezing in the winter of 1917–18, the quantity of green material turned under in the spring of 1918 being negligible. Sorghum was grown after peas on two plats. Cotton followed peas on four plats. The yields from three of these were above the average of all plats, while the fourth yielded less than half the average of all plats. In 1916 and 1917 the yield of seed cotton in this rotation was the lowest obtained on any rotation plat.

Cowpeas were seeded on two plats after oats on July 30, 1917. On account of dry weather they made little growth. One plat was plowed on October 1 and the other was plowed and subsoiled on November 1. The average yield of cotton on these two plats in 1918 was nearly 25 per cent less than the average from all plats.

The results with green manuring obtained to date indicate that cowpeas as a catch crop after corn or oats are not satisfactory, owing to dry weather during the summer and the inability to grow a crop regularly. Rye can ordinarily be grown as a winter crop, but it has had a very depressing effect on the yields of the succeeding crop of cotton. Field peas as a winter crop appear to be the most reliable crop for green-manure purposes, and the best adapted varieties are seldom injured seriously by freezing. However, the results obtained at the experiment farm do not show that crop yields have been increased perceptibly by plowing under any of the green-manure crops being used.

BIENNIAL CROPPING AND FALLOWING.

The results of biennial cropping and fallowing were more favorable to this practice in 1918 than in past years. Cotton, corn, oats, and sorghum were grown by this method. Oats yielded 28.6 bushels under biennial cropping, as compared with 6.33 bushels produced under annual cropping. The continuously cropped plat, however, was not plowed until fall. The 8-year average yield of oats has been nearly twice as much with biennial as with annual cropping. Cotton yielded in 1918 nearly twice as much under biennial as under annual

cropping, but the average yield for eight years is less with biennial than with the annual cropping. Corn in biennial cropping yielded about 75 per cent more than in annual cropping. The 8-year average, however, is lower for the biennial than for the annual system.

EFFECT OF ROTATION AND TILLAGE ON COTTON ROOT-ROT.

Root-rot is one of the most serious plant diseases with which the farmer in the San Antonio region has to contend. It affects cotton, probably the most important crop, and seems to affect most deep-rooted plants, including alfalfa, fruit, and ornamental trees, and some of the garden crops. The disease has been studied in various ways in connection with the rotation and tillage experiments in an effort to determine practical methods of overcoming its effects. The dead plants have been counted each year since 1913 and charts showing the exact location of these root-rot areas on each plat have been made for each of the past three years.

It has been observed that as a rule root-rot is much less serious where cotton is grown in rotation than where grown year after year on the same land. The number of dead plants in a certain rotation of oats, cotton, and milo has been very small every year. Near by this rotation is a plat cropped continuously to cotton. The infection on this plat for 1916, 1917, and 1918 has averaged about 57 per cent of the plants. Lying alongside this plat is one cropped continuously and manured each year at the rate of 16 tons per acre. It has averaged for these three years about 46 per cent of dead plants. Until 1918 the percentage of infection was appreciably lower on the manured than on the unmanured plat. In 1918 the reverse was true. It seems therefore that manure can not be expected to reduce the extent of root-rot.

The time of preparing the land seems to exert some influence. Infection has been somewhat higher as a rule on plats plowed in the spring than on plats in similar rotations where the plowing was done in late summer or early fall.

It is quite plain from a study of the location of the dead plants that infection does not occur in the same spot each year that cotton is grown on the land. It appears necessary to obtain more data in order to determine satisfactorily the nature of the disease and proper methods for its control.

EXPERIMENTS WITH COTTON.[1]

The work with cotton which has been conducted in cooperation with the Office of Crop Acclimatization and Adaptation Investigations for a number of years was continued in 1918. The experiments

[1] This report was furnished by the Office of Crop Acclimatization and Adaptation Investigations of the Bureau of Plant Industry.

consisted of (1) acclimatization studies of varieties from Mexico, Central America, Africa, and Asia; (2) tests of local varieties and cultural experiments; and (3) breeding work with the Lone Star, Acala, and Kekchi varieties.

The season of 1918 was the most unfavorable for cotton in the history of the San Antonio Experiment Farm. Cotton in all experiments was planted on April 9, and good stands were secured. The very favorable conditions of early spring promoted rapid growth, which was suddenly checked by the drought which became effective about July 1. This resulted in the shedding of a very large percentage of the squares and young bolls, and the plants never recovered from this setback. All results, therefore, must be considered with these facts in mind.

In a test in which the Acala and Lone Star were compared with Mebane's Triumph and Rowden, two varieties of the big-boll type commonly grown in Texas, all the varieties gave approximately the same yield. The conditions were so severe that none of the cotton had an opportunity to develop satisfactorily. The lint of the Acala variety was somewhat longer than that of the other varieties, while the lint of Mebane's Triumph was the shortest.

Lone Star cotton was again used in a time-of-thinning test. The experiment consisted of 30 rows, 4.1 feet apart, 132 feet long, and was divided into 6 blocks of 5 rows each. Every seven days 5 rows were thinned to approximately 8 inches. The first rows were thinned on April 22 and the last rows on May 20. The last 5 rows were not thinned. The rows thinned on May 6 gave the highest yields of seed cotton.

A test was made comparing 4, 8, 12, and 16 inch spacing in rows 4.1 feet apart. There were 4 rows 132 feet long of each spacing. All rows were thinned on May 10. The rows with plants spaced at 12 and 16 inches gave practically the same yields. The rows with plants spaced at 8 and 4 inches yielded, respectively, 18.3 per cent and 49.1 per cent less seed cotton than those with wider spacing. Earlier thinning of close-spaced rows would seem to be indicated.

The experiment begun in 1915 to secure data regarding yield and quality of lint with an equal number of plants per acre in rows at varying distances apart was modified in 1918. In 1918 the experiment consisted of 24 rows 132 feet long. Eight rows 2 feet apart were planted in hills 2 feet apart and later thinned to 1 plant per hill. Eight rows 3 feet apart were planted in hills 3 feet apart and later thinned to 2 plants per hill. Eight rows 3 feet apart were planted in hills 18 inches apart and later thinned to 1 plant per hill. The 3-foot rows with plants spaced 18 inches apart gave the highest yields, the rate being the equivalent of 297 pounds of seed cotton per acre.

EXPERIMENTS WITH CORN.

WORK OF THE OFFICE OF CORN INVESTIGATIONS.[1]

Tests of interplanting long and short season varieties as a means of increasing acre yields were continued. The combined yields from the Laguna (a late variety) and Selection 133 (an early variety) planted in this manner gave an increase of 9 and 10 bushels, respectively, as compared with the same varieties in pure plantings. Increases of 6 and 11 bushels per acre were obtained from the Laguna and 100-day Bristol grown in this manner, as compared with pure plantings of these two varieties. The results obtained in 1918 and in previous tests indicate that this method of planting can be used profitably in the San Antonio region and in other localities where similar conditions prevail.

In localities where dry weather is normally a limiting factor in corn production the general practice among farmers favors thin stands, the common opinion being that greater yields and a better quality of grain are obtained if the plants have "plenty of room." This is probably true within certain limits, but frequently the stands are too thin for the best yields. In the experimental plats the highest yields have been obtained where the plants were considerably thicker than in ordinary farm practice; the size of ears was somewhat reduced, but the quality of grain was not materially affected.

Some general observations have seemed to indicate that some varieties produce much more advantageously with thin stands than other varieties. To obtain more information on these points three distinct varieties were so planted and thinned as to provide 4.1, 6.15, 8.2, 12.3, 14.3, 16.4, 18.4, and 20.5 square feet of land per plant. Two of the varieties were single-ear types, although both would produce second ears under certain conditions, one to a greater extent than the other. The third variety was a small-ear prolific type. The varieties were studied as to the effect of the different spacings upon acre yields, yields per plant, amount of suckering, number of ears per plant, and average weight of ears. The maximum yields of all three varieties were obtained at the closest spacing 4.1 square feet per plant. The total yields of the varieties, with very little inconsistency, decreased as the spacing was increased, but the rate of decrease was not the same in all varieties, indicating wide differences in the degree to which the varieties reacted to the varying stands. The yields per plant consistently increased up to a spacing of 12.3 square feet per plant for one variety and 14.3 square feet for the

[1] This report was furnished by Mr. E. B. Brown, of the Office of Corn Investigations, Bureau of Plant Industry.

other two varieties. The increases were not proportionate in the spacings greater than 14.3 square feet per plant. The greatest increase in yield per plant for the single-ear varieties was from 0.449 pound at 4.1 square feet spacing, to 0.886 pound at 14.3 square feet spacing. In the case of the prolific variety the increase in yield per plant through the first five spacings was from 0.465 pound to 1.155 pounds.

The amount of suckering was not consistently affected by differences in spacing. The prolific variety, however, with greater spacing increased the rate of suckering much more than did the single-ear varieties.

The number of ears per plant increased consistently in the case of one of the single-ear varieties—from 1 ear per plant at 4.1 square feet to 1.78 ears at 12.3 square feet. After this distance increased spacing did not bring about a consistent increase in the number of ears per plant, although the greatest number (1.82 ears) was obtained at 20.5 square feet. The other single-ear variety consistently increased from 0.96 ear per plant at 4.1 square feet to 1.62 ears at 14.3 square feet, after which there was no consistent increase. The prolific variety, with but one exception, consistently increased from 1.23 ears per plant at 4.1 square feet to 3.24 ears at 20.5 square feet.

The weight of ears did not increase consistently with increased spacing, except from 4.1 square feet to 6.15 square feet. The average weight of ears of two of the varieties for the four widest spacings was less than for the four narrowest spacings. One of the single-ear varieties gave an increased average weight of ear for the four widest spacings as compared with the four narrowest. The indications were that two of the varieties tended to increase their grain production per plant by putting on additional ears, while the third variety did so by increasing the size of ears rather than the number of ears.

The results indicate that in this test the prolific type has been much more efficient in increasing its yield per plant to make up for deficiency in stand than have the single-ear varieties.

This ability on the part of a variety to increase the grain yield per plant in order to make up for deficiencies in stand has received little attention from the farmer, but is one to which he could well give attention in making a choice of varieties, as in general field growing thin stands are rather the rule, and missing places are frequent. The variety that best adapts itself to these conditions, other things being equal, should be the most valuable.

A number of strains of Mexican June corn obtained from Mississippi, Louisiana, Texas, and Arizona were tested in single rows. The strains differed in time of maturity. The Louisiana strains were

the earliest; a strain from Tucson, Ariz., was the latest. There was little difference in the yields of the different strains with the exception that those from Louisiana yielded several bushels less per acre than the strains from Mississippi, Texas, and Arizona. The Mexican June variety has proved to be a good type for general corn growing in this section.

Thirty-one varieties of flour corn from Peru were tested, but were apparently of no value for this region.

TEXAS FIELD CROPS ASSOCIATION VARIETY TEST.

As had been done during the past several years, a variety test of corn was conducted for the Texas Field Crops Association in 1918. The test consisted of 20 strains or varieties in 16-rod rows, with a check variety every third row. The seed was collected by the secretary of the association and was sent to the experiment farm so late in the season that planting was done much later than is advisable under San Antonio conditions. The result of the late seeding and the generally unfavorable character of the season for corn growing was a complete failure of all varieties, and none were harvested.

OBSERVATIONS ON THE PRODUCTION OF ROASTING EARS.

The production of corn for sale as roasting ears is attended by rather great difficulties throughout the South, on account of the extensive damage done by the corn earworm to ordinary varieties of sweet corn. In the San Antonio region, nearly all of the roasting ears produced locally are of the common field-corn varieties. Such roasting ears are not of the best quality, and their season of production is limited to a few days during the season. A small area of Papago[1] sweet corn (S. P. I. No. 42642) was grown on the experiment farm in 1918, and very encouraging results were obtained. This variety of corn was introduced by the Arizona Agricultural Experiment Station, having been selected from a type of corn grown by the Papago Indians. It produces roasting ears of fair quality, is very productive, and was not so severely damaged by corn earworms as other varieties of sweet corn. Another distinct advantage of this variety is that it may be produced during the hottest summer months, and thus a constant supply of roasting ears made available through a long season.

Observations on the use of field-corn varieties for roasting ears indicate that prolific varieties have some advantages for this purpose. With irrigation they are usually productive, each stalk bearing from two to four ears. The ears vary in their time of development, thus

[1] Seed for this planting was furnished by the Office of Corn Investigations of the Bureau of Plant Industry.

prolonging the season. The ears are of medium size, which is desirable for roasting-ear purposes, and while not of a quality equal to the better varieties of sweet corn they were better than most of the larger-eared field sorts commonly used.

CORN AND COWPEAS IN WIDE-SPACED ROWS.

The experiment in planting corn and cowpeas in wide-spaced rows was outlined in its present form and first conducted in 1915. The results in 1915[1] apparently favored spacing the corn rows farther apart than is ordinarily practiced in the region. The experiment was repeated in 1916 and 1917, but on account of the poor seasons the yields were negligible.

In 1918 this experiment was made on field C6, which had produced cotton in 1917 and had been plowed the early part of December of that year. It occupied 40 rows 264 feet in length. The field was divided into two sections, making the rows in each section 132 feet long. Each section was divided into four plats of 10 rows each, the distance between the rows varying from 4.1 to 7 feet.

The corn in this experiment was planted on March 6, 1918. A good stand was secured except in some of the wide-spaced rows, where poor germination resulted on account of shallow planting. Whippoorwill cowpeas were seeded between the corn rows in the east section on May 14, when the corn was about 3 feet high. The peas germinated promptly, and a good stand was obtained on all plats except in the 4.1 feet rows, where the stand was very thin.

The corn had been thinned on April 15, and an attempt made to leave approximately the same number of plants per acre on all plats; that is, the plants were left sufficiently close together in the wide-spaced rows to accomplish this.

The yields of corn on the various plats are shown in Table IV.

Table IV shows that the highest yield of corn was obtained on the plat where the rows were 5 feet apart and no cowpeas were planted. As a rule, the yields where cowpeas were grown between the corn rows were higher than where no cowpeas were grown. It is not believed, however, that the growing of the cowpeas between the corn rows is responsible for this. It may be observed that the yields were not consistently influenced upward or downward by the distance between the rows. On the whole, the experiment was very unsatisfactory, the appearance of the corn during the growing period showing plainly the lack of uniformity of the land, particularly as regards the moisture supply, though the field had been uniformly treated. In general, growth was much better on the

[1] Hastings, S. H. The work of the San Antonio Experiment Farm in 1915. U. S. Dept. Agr., Bur. Plant Indus., West. Irrig. Agr. Cir. 10, 17 p., 2 figs. 1916.

east section than on the west, but the highest yield was obtained on plat 2 in the west section. A good deal of run-off resulted from rains occurring in May, and it is believed that this was the cause of the lack of uniformity of soil-moisture conditions in the field.

TABLE IV.—*Yields of corn in wide-spaced rows on the San Antonio Experiment Farm in 1918.*

Section and plat.	Distance between rows.	Average—				
		Plants.		Yield.		
		Spacing in row.	Per acre.	Per row.	Per plant.	Per acre.
	Feet.	*Inches.*	*Number.*	*Pounds.*	*Pounds.*	*Bushels.*
West section (without cowpeas):						
No. 1	4.1	24.3	5,208	22.7	0.35	25.9
No. 2	5	21.2	4,830	44.9	.60	42.3
No. 3	6	17.3	5,022	35.6	.39	28.0
No. 4	7	15.9	4,701	31.0	.31	20.9
East section (cowpeas between corn rows):						
No. 5	4.1	23.7	5,336	33.5	.50	38.3
No. 6	5	22.0	4,745	36.5	.51	34.4
No. 7	6	16.8	5,198	42.0	.44	33.0
No. 8	7	15.1	4,965	57.3	.54	38.6

The cowpeas grew slowly until the corn was mature. Showers the last of July and the last part of August furnished moisture which resulted in more rapid growth. Much the best growth of cowpeas was made between the corn rows which were 7 feet apart. Before cutting the cowpeas, mature pods were harvested from all plats. The vines were then cut with hoes and allowed to cure several days in the field. The pods were picked on October 8 and the vines cut on October 9. The vines were hauled and weighed on October 16.

The yields of mature pods and of field-cured hay from the different plats are shown in Table V.

TABLE V.—*Yields of cowpeas in the corn and cowpea experiment, field C6, on the San Antonio Experiment Farm in 1918.*

Plat.	Distance between corn rows.	Yield (pounds).			
		Mature pods.	Hay.	Vine and unmatured pods.	Total per acre.
	Feet.				
No. 5	4.1	8	85	93	744
No. 6	5	12½	85	97.5	613.5
No. 7	6	16	150	166	913
No. 8	7	54½	280	334.5	1,579

After becoming thoroughly dry, the cowpeas were weighed. Meantime, however, the pods from plats 5, 6, and 7 had been bulked together. The yield of thrashed peas from these three plats was 30

pounds, and the yields of cowpeas from plat 8 was 28 pounds, or at the rate of 60 pounds, or one bushel, per acre. A view of the corn and cowpeas in rows 7 feet apart is shown in figure 3.

Based upon observations and the results of these experiments, it is concluded that planting cowpeas between wide-spaced rows does not result in an increased yield of corn. Where the cowpeas are seeded at the time of planting corn or soon after, they compete with corn for the moisture supply and decrease the yield. If the cowpeas are not seeded until the corn is 2 or 3 feet high, the cowpeas will not decrease the yield of corn to any appreciable extent. There appears to be no particular advantage in growing corn in wide-spaced rows unless it

FIG. 3.—Corn in rows 7 feet apart with cowpeas between the corn rows on the San Antonio Experiment Farm. This system is sometimes recommended for semiarid regions and for poor soils in humid regions.

is desirable to interplant with another crop, such as cowpeas or peanuts. This might be very desirable on certain soil types or under certain conditions of farm practice. Where approximately the same stands per acre are obtained in normal and wide-row planting, there has been no great difference in the yields obtained. Whether wide or narrow row spacing is to be practiced would appear, therefore, to depend upon other factors than the yield of corn.

EXPERIMENTS WITH SORGHUMS.

Seed of a large number of varieties of grain and forage sorghums was furnished by the Offices of Cereal Investigations and Forage-Crop Investigations for a varietal test in 1918. Many of the varie-

ties used in a similar test in 1917 were represented, together with some additional varieties.

Soil-moisture conditions were extremely unfavorable during March; consequently the planting of the variety test was delayed until April 9, 1918. Precipitation amounting to 0.96 inch had occurred on April 6, which put the surface soil in good condition. Good stands of nearly all varieties were obtained. In a few instances the seed appeared to be of low vitality.

The test was located on the south end of field C6, which had been used for cotton experiments in 1917 and had been plowed the early part of December. Each variety occupied 4 rows, 264 feet long and 4.1 feet apart, making a plat one-tenth of an acre in size.

Growing conditions were reasonably favorable during April and May. On account of the scant winter precipitation there was no reserve supply of moisture stored in the soil: consequently the crops began to suffer from drought early in June or when showers ceased to occur as needed.

By the time the varieties began to bloom, sorghum midges had become very numerous. They had multiplied in the milo in the rotation experiments, which were seeded earlier than the varieties, and perhaps in the Johnson grass and other sorghums; consequently all of the varieties in this test were very seriously damaged by this insect. While the injury varied much on the different varieties, none escaped severe damage, but there seemed no definite correlation to account for the wide variation in its extent.

As such a small proportion of the heads had set seed, it was thought desirable to cut the filled heads from the standing stalks and later cut the stover with a row binder (see the title-page illustration). The broom corn was pulled on July 15, and the sorghum varieties were headed on July 18, 19, and 20. All heads which had any appreciable quantity of seed were cut. They were piled on the ground and after sufficient drying were thrashed on July 19.

The stalks of all varieties were cut with the row binder on July 26. The bundles were left where they fell for a few days and were then shocked to cure in the field. After curing, the fodder of each variety was hauled in and weighed separately.

Table VI shows the variety, number, source, estimated midge damage, average height, and yield of grain and stover per plat and per acre.

There was a wide variation in the grain yields of the different varieties of sorghum. As mentioned before, it is thought that this was largely due to differences in the damage done by the sorghum midge. The wide difference in midge injury was attributed to the variability in time of flowering of the different varieties, though it may have been partly due to other factors. Observations during many

seasons have indicated that the extent of midge damage is dependent upon the relative numbers of the insects present at flowering time rather than upon any difference in the resistance of the different varieties.

TABLE VI.—*Yields of sorghum varieties on the San Antonio Experiment Farm in 1918.*

[Abbreviations: C. I., Office of Cereal Investigations; F. C. I., Office of Forage-Crop Investigations S. P. I., Office of Foreign Seed and Plant Introduction.]

Variety.	Serial No.	Source.	Height.	Midge damage.	Yield per plat (pounds).		Yield per acre.	
					Grain.	Stover.	Grain.	Stover.
			Ft. In.	*Per cent.*			*Bushels.*	*Pounds.*
Dwarf milo	C. I. 332	C. I.	5 3	80 to 90	29.5	504	5.3	5,040
Feterita	C. I. 182	C. I.	6 6	50 to 60	57.5	390	10.3	3,900
Do	S. P. I. 22329	F. C. I.	7 0	40 to 50	107	400	19.1	4,000
Dawn kafir	C. I. 340	C. I.	5 0	50	63	310	11.3	3,100
Sunrise kafir	C. I. 472	C. I.	6 6	60 to 70	69	490	12.3	4,900
Brown kaoliang	C. I. 171	C. I.	6 0	60	55.5	200	9.9	2,000
Kaoliang	C. I. 309	C. I.	6 6	60	40	210	7.1	2,100
Shrock kafir	F. C. I. 1481	F. C. I.	5 0	80 to 90	24	374	4.3	3,740
Dwarf hegari	S. P. I. 34911	F. C. I.	5 3	60	25.5	520	4.6	5,200
Sweet kafir	S. P. I. 32707	F. C. I.	7 0	40	64.5	430	11.5	4,300
Darso sorghum	F. C. I. 1530	F. C. I.	5 0	75	46	280	8.2	2,800
Whooper sorghum	F. C. I. 5873	F. C. I.	6 0	40	119	298	21.3	2,980
Clubhead sorghum	F. C. I. 8708	F. C. I.	6 3	60	67.5	430	12.1	4,300
Sumac		Local	6 6	60	50	420	8.9	4,200
Dwarf broom corn		C. I.	4 9		28	[a] 100	5	[a] 1,000
Acme broom corn	C. I. 243	C. I.	5 3		52	[a] 168	9.3	[a] 1,680

[a] Well-cured brush.

All of the grain yields were rather low. Had the varieties escaped midge damage, it is believed the yields would have averaged at least three times as large. The results show plainly the risk involved in the late seeding of sorghum for grain production. Considering the season, the yield of broom corn was satisfactory. The yields of stover were more indicative of the adaptability of the different varieties. The highest yields of stover were from the kafirs, milo, and Sumac sorghum. The yield of Sunrise kafir was approximately 2½ tons per acre; it was outyielded only by Dwarf milo. The quality of kafir forage being much superior to that from milo suggests its more general use in the region for a combination grain and forage crop or for silage.

EXPERIMENTS WITH FLAX.[1]

Experiments in growing flax as a winter crop have been made at the experiment farm during each of the past five years. The work has consisted of variety tests in field plats and nursery rows and date-of-seeding tests. In certain years favorable results have been obtained, but in other seasons the flax has been severely damaged or

[1] The work with flax has been done in cooperation with Mr. C. H. Clark, of the Office of Cereal Investigations of the Bureau of Plant Industry.

entirely killed out by freezing or the yield has been very low as a result of drought.

On account of the extremely dry weather which prevailed throughout the winter of 1917–18, no land with sufficient moisture to germinate the seed was available for seeding flax at the usual time in early winter. Conditions were such that little seeding could be done until after the rains of February. Even though considered very late for seeding, five varieties were seeded in tenth-acre field plats and 13 varieties in 16-rod nursery rows on February 23, 1918. No date-of-seeding test was made in 1918. Light rains which came at intervals during the spring and early summer made conditions reasonably favorable for the early growth of flax. However, there was an inadequate supply of soil moisture for the best development of the seed crop, the result being rather poorly filled bolls and a large proportion of light and shrunken seed. The varieties in field plats were harvested with a mower and thrashed with a machine and the varieties in nursery rows were harvested and thrashed by hand, the seed being cleaned by means of an electric fan.

Table VII shows the varieties tested in field plats and in nursery rows, respectively, and the results obtained.

TABLE VII.—*Yields of flax varieties in tenth-acre plats and in 16-rod nursery rows on the San Antonio experiment farm in 1918.*

Variety.	C. I. No.	Estimated stand at harvest.	Average height.	Yield of grain per acre.
		Per cent.	*Inches.*	*Bushels.*
In tenth-acre plats:				
North Dakota No. 1214	2	90	20	8.2
Damont (North Dakota No. 1215)	3	90	18	7.7
North Dakota Resistant No. 114	13	90	18	7.1
North Dakota No. 1241	16	100	18	7.9
Smyrna	30	40	17	5.0
In 16-rod nursery rows (16 inches apart):				
North Dakota No. 1214	2	90	20	7.4
Damont	3	90	20	9.6
North Dakota Resistant No. 114	13	90	18	8.8
North Dakota Resistant No. 73	14	90	18	6.1
Fargo common	18	90	20	8.3
Russian	19	40	20	2.4
Punjab	20	95	12	7.6
Golden	25	95	12	2.2
Smyrna	30	95	13	4.6
Soddo	38	95	11	7.2
No. 26-7	148	100	16	2.2
No. 27-5	149	95	18	5.5
No. 64-6	152	90	20	7.4

Cereal Investigations Nos. 2, 3, and 16, all being of the Russian seed-flax type, are the best in this test. C. I. No. 13 (North Dakota Resistant No. 114) is a slender-stemmed flax with a smaller head. While its yield both in the field plats and nursery series is slightly lower than that of the Russian varieties, it is said to be the variety most resistant to flax wilt so far produced. The Smyrna variety is too short to be easily harvested, and its yield was the poorest in the

test in field plats. C. I. No. 38, an Abyssinian flax, and C. I. No. 20, an Indian flax, are so short as to make harvesting very difficult. The yield of C. I. No. 25, Golden flax, was very low in 1918, though in previous years it had been comparatively good. The variety is rather late in maturing, which makes it unsatisfactory under San Antonio conditions.

The yields of flax in 1918 were much better than in 1917 and somewhat better than in 1916. Even then the yields were not large enough to encourage growing flax in place of the staple crops commonly grown in the San Antonio district.

EXPERIMENTS WITH BEAN VARIETIES.

The production of dried beans for human food continues to be of local interest. This is particularly true as regards some of the newer or more recently introduced varieties, such as the tepary and the pinto. In order to obtain further data on the relative adaptability of the different varieties, a test similar to that previously made was repeated in 1918. On account of unfavorable soil-moisture conditions, planting could not be done until April 11. Each variety occupied a plat consisting of six rows 264 feet long and 3 feet apart. The experiment was made on field B4 on land that had grown corn in 1917. Good stands of all varieties were obtained. The following varieties were represented in the test: California Pink, pinto, tepary, Whippoorwill and Blackeye cowpeas, Speckled Lima, and Henderson Bush Lima. Rains during May and early June kept the beans growing fairly well. When the weather became dry and hot the latter part of June, the California Pink and the pinto beans began to ripen and the plants began to die. On July 10 both of these varieties were harvested, practically all of the plants being dead. The plants were small, from 8 to 10 inches in height, and apparently the pinto beans had made a somewhat better growth than the California Pink beans. At best, the crops of both were very poor, and the yield of beans was small. On August 6 and 7 the Speckled Lima, the Henderson Bush Lima, and the Blackeye cowpeas were harvested. None of these varieties had done especially well, the plants being small and poorly developed. The different varieties yielded at the following rates per acre:

	Pounds.
California Pink	14
Pinto	45
Henderson Bush Lima	135
Speckled Lima	50
Blackeye cowpeas	270

The Whippoorwill cowpeas were too late in maturing for the season, and while the vines remained alive, they fruited very little

and were not harvested. The tepary beans made reasonably good vine growth early in the season, but about the time they began to bear they began dying and did not produce a crop. Whether their death was due to seasonal conditions or to some disease was not determined. No disease was apparent, and if the same variety had not remained green throughout the dry, hot summer the preceding season, it would have been concluded that the death of the vines was due to drought.

The results of the test with bean varieties in 1918 and in previous years indicate that beans probably can not be made a commercial crop in the region, except possibly under irrigation. The California Pink and pinto beans are not adapted for growing unless they can be planted rather early in the spring and a crop produced before the hot, dry weather of summer. The Henderson Bush Limas appear to be adapted to survive the hot weather fairly well and could probably be made profitable under irrigation.

Of all the varieties of dried beans tested the Blackeye cowpeas appear to be best adapted to conditions and should probably be most generally used for the production of such beans for home consumption. While not so valuable for marketing as some of the others, this variety produces beans of fair quality which are well adapted for home use. Moreover, they can be used as a substitute for string beans during the hot season when ordinary string beans can not be produced.

RHODES GRASS.

Rhodes grass is a perennial grass crop which was first introduced by the United States Department of Agriculture in 1903. Not until 1910, however, was sufficient seed available to make it possible to give it an extensive test. Since 1910 it has been tested in many parts of the South and has gained rapidly in popularity. It was first tested on the San Antonio Experiment Farm in 1911. The severe winter of 1911–12 resulted in killing out a large proportion of the plat, and it was plowed up. By chance a few plants remained near an old irrigation flume, where the land was uncultivated, and the grass persisted, gradually spreading in all directions. During the succeeding four years the winters were reasonably mild and the grass was uninjured by freezing. In 1917 the flume was removed and the grass was killed out by cultivation. General interest in the crop and observations on the grass plat mentioned above indicated the desirability of making further trials. A quantity of seed was therefore obtained from the Office of Forage-Crop Investigations of the Bureau of Plant Industry, and about half an acre was seeded in 1917. A good deal of difficulty in securing stands had

been reported from various sources in Texas, and several different methods of seeding were used.

Methods of seeding were tried on field B4 on land which had been fallow since it was plowed early in the fall of 1916. Seeding was done on May 9, 1917, after light showers had put the surface soil in good condition. The seed was sown broadcast and in rows 3 feet apart. Shallow furrows were made with a garden cultivator for the row seedings. The seed on the broadcasted area was covered in three ways. Part of it was harrowed lightly with a spike-tooth harrow, another part was rolled with a hand roller, and the remaining part was left without covering, with the idea that later showers would cover it sufficiently. A part of the seed in rows

FIG. 4.—A field of Rhodes grass on the San Antonio Experiment Farm just before the first cutting in May, 1918. This grass was seeded in May of the preceding season. Rhodes grass is becoming a popular forage crop in certain sections of Texas where the winters are not too severe.

was rolled and a part was left uncovered. Showers occurred on May 9, 10, 11, 12, and 19, after seeding. This made conditions rather favorable for germination. However, rather poor stands were obtained on all areas. The best stand was secured on the broadcasted area that was rolled and where seeding was done in rows. Harrowing apparently covered the seed too deep.

The Rhodes grass survived the winter of 1917–18 with practically no loss in stand. The minimum temperature during the winter was 9° F. A condition which probably favored the grass was the presence of some sleet and snow at the time of the severest weather. On December 9, 1917, a minimum temperature of 15° F. was recorded,

which the grass survived in good condition. At this time no protection was afforded by sleet and snow. Rhodes grass has not generally been considered to be hardy to temperatures much below 20° F.

The plants were allowed to reach full maturity before cutting in 1917 in order that the seed might be scattered and the stand thereby thickened. Only a part of the 1917 growth was cut, the remainder being left to afford protection. Observations did not indicate that the protection afforded by this growth had any noticeable effect upon the winter survival, but the stand in 1918 thickened much more rapidly where the 1917 growth was uncut than where cut.

The grass started early in 1918 and made very rapid growth during the first part of the season. A view of the plats just before the first cutting was made on May 31 is shown in figure 4.

The grass was cut four times during the season, the last cutting being made just before frost. The total yield of field-cured hay was 2.91 tons per acre. Considering the poor stand and the unfavorable season, this is considered a very satisfactory yield.

Our experience with Rhodes grass is not sufficiently extensive to enable us to recommend its general use in the San Antonio district. It is possible that it may not be sufficiently hardy to cold, and the stands may be killed occasionally. The seed is high in price, and there is often difficulty in securing a stand. Unless the stand will endure for a number of years, attempts to establish it will not be justified. The grass when once established seems very resistant to drought. This was shown by its survival and behavior during the extremely dry season of 1917.

HORTICULTURAL EXPERIMENTS.

The horticultural experiments consist of testing varieties of fruits and methods of culture for fruit crops, the testing and acclimatization of foreign fruit and nut trees likely to be adapted to local conditions, and the testing of various plants suitable for stocks on which to bud or graft improved varieties.

Even though the mean temperature during the winter of 1917–18 was appreciably below normal and extremely low temperatures were recorded, no late spring frosts occurred, so that nearly all deciduous-fruit trees set heavy crops. Many varieties which commonly fail to bear on account of early blooming and subsequent frost injury fruited in 1918. Had conditions been favorable for the development of the fruit, a very heavy crop probably would have been obtained, but the lack of soil moisture resulted in some fruit falling off before maturity, and much of that which remained failed to mature satisfactorily, the fruit being small and the yield consequently low. By the

extreme cold of winter all citrus trees except citranges and all figs, olives, and pomegranates were killed to the ground. Even citranges were rather seriously damaged by the freeze. Of the several varieties the Rusk citrange was the least affected, its injury being limited to freezing back the growing branches and practically complete failure of the fruit crop for the season. Date palms were rather severely frozen back, in many instances all but the most protected leaves being killed.

Conditions during the winter were not favorable to the growth of trees, since there was insufficient soil moisture. As a result, very poor growth was made during the season, and many trees died from causes resulting directly or indirectly from drought.

No important additions were made to the horticultural plantings in 1918. A few plants were transplanted from nursery and greenhouse to orchard locations. Soil conditions were so unfavorable during the season for setting out trees that it was not considered desirable to transplant any large number.

PEACHES.

An unusually large number of peach varieties fruited in 1918. A total of 134 peach trees on the experiment farm bore in 1918, 44 of which represented 34 named varieties, the remaining 90 being Mexican seedling trees. In most instances, however, the yields per tree were rather light. The varieties which in previous years have been found to be the surest bearers produced the heaviest crops of fruit in 1918. These are peaches of the Spanish and South China races and some of the better seedlings in the Mexican seedling orchard.[1]

The varieties found best adapted for planting in home orchards are the Pallas, Honey, Imperial, and Climax. To these may be added certain of the trees selected from the Mexican seedling orchard, which for the most part are not yet available through commercial sources. All of the varieties so far found adapted to the climatic conditions are thin skinned and will not stand shipment, and consequently their use is limited to home consumption or for sale on local markets. None of the standard commercial varieties so far tried will bear with fair regularity under the conditions prevailing at San Antonio. The Tuskena peach (S. P. I. No. 26824) is a variety lately added to the collection, which appears to be promising. The fact that it ripens late in September, thus perhaps providing fruit at a season when there is a shortage, will make it a very desirable variety in case it proves to be well adapted to conditions.

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[1] For detailed information concerning the collection of Mexican seedling peaches, see Hastings, S. H., and Blair, R. E., Horticultural experiments at the San Antonio Field Station, southern Texas, U. S. Dept. Agr. Bul. 162, 26 p., 8 figs. 1915.

PLUMS.

Nearly all the varieties of plums in the orchards of the experiment farm fruited in 1918. Most of the trees were young, and the production was not especially heavy, though in most instances the trees bore what was considered a good crop. There were 23 trees, representing 21 varieties, which fruited in 1918. The plum is perhaps the most reliable producer and best adapted to San Antonio conditions of any fruit tree tried at the experiment farm.

The results in 1918 confirmed the results of previous years as to the choice of varieties. The best varieties have been found to be the Gonzales, Burbank, Wickson, Eagle, and Terrell. Of varieties more lately added to the collection the Shiro, Happiness, and Santa Rosa are promising.

APRICOTS.

While a large number of varieties of apricots have been assembled in the station orchards, no variety has been found which bears fruit with any degree of regularity. Apricots are frequently reported as bearing large crops in this region. The cause for the failure of this fruit on the experiment farm has not been determined. It is thought that possibly the soil is rather too fertile, causing vegetative growth at the expense of fruit production. In 1918 one apricot tree of the Bexar variety produced a few fruits.

ALMONDS.

No killing freezes occurred after the blooming period for almonds in 1918. A number of the trees in the station orchard are of bearing age. It was expected, therefore, that at least some of them would fruit. A few fruits developed on each of several different trees, not more than a half dozen in any instance. It appears that the almond is not at all promising for the San Antonio district.

GRAPES.

A large number of grape varieties have been tested at the experiment farm. Many of them have not been able to survive the rather unfavorable soil conditions where they were planted, the soil being of a heavy type, high in lime content. Many have died from root-rot, and some varieties are particularly susceptible to chlorosis, which results in poor growth and finally in the death of the vines. The following varieties fruited in 1918: Lukfata, Valhallah, Champanel, Muench, Black Spanish, and Xenia. Of these, the Lukfata variety bore much the heaviest crop, with the Valhallah and Champanel next. These three varieties, ranking in the order named, have shown their adaptability to the local soil and climate conditions.

The Lukfata and Valhallah varieties are especially resistant to chlorosis, making a good growth and keeping a deep-green color when other varieties turn yellow and finally die. While the fruit of these varieties is not of the best quality, it is very acceptable for home use and for canning and preserving. These varieties are especially recommended for planting on the soils of the region that are similar to that of the experiment farm.

MISCELLANEOUS FRUITS.

The jujubes bore a heavy crop in 1918. The young jujube trees which were added to the collection in 1916 bore a few fruits. The trees bear regularly and apparently are well adapted to the severe climatic conditions which often prevail. Only one variety of Japanese persimmon fruited in 1918. Japanese persimmons usually have been regular bearers.

ORNAMENTAL PLANTINGS.

No new species were added to the ornamental plantings in 1918. In a few instances plants which had died were replaced by sorts which had been found better adapted to the conditions. The different ornamental palms were somewhat injured by cold during the winter, some rather seriously. Those most seriously injured were *Phoenix canariensis*, *Glaucothea armata*, *Cocos australis*, and *Inodes* (*Sabal*) *exul*. The conditions during the season were rather severe on ornamentals, and growth was slow and unsatisfactory, even with irrigation.

EXPERIMENTS IN ROOT-ROT CONTROL.

Experiments in the control of root-rot in cotton were continued in 1918 on fields AB8 and C5. These fields were also used for similar experiments in 1916 and 1917. The experiments in 1918 consisted of acid-phosphate treatment, mulching with coarse manure and straw, and observations on the development of root-rot on the areas excavated in 1917.

SOIL TREATMENT.

A detailed statement of the soil treatments used in 1916 and 1917 in an attempt to prevent the spread of root-rot in cotton was made in a previous report.[1]

In these tests acid phosphate and calcium acid sulphate were used at the rate of 1,000 pounds per acre in comparison with no treatment. A careful study of the data for 1916 and 1917 showed that the treat-

[1] Letteer, C. R. The work of the San Antonio Experiment Farm in 1917. U. S. Dept. Agr., Bur. Plant Indus., West. Irrig. Agr. Cir. 21, 28 p., 4 figs. 1918.

ment had no effect in reducing the extent of root-rot infection. In order to confirm the results of previous years, the same plats used in 1916 and 1917 were used for a similar experiment in 1918. Owing to the difficulty of obtaining calcium acid sulphate, it was decided to use acid phosphate on those plats which had been treated with calcium acid sulphate in 1916 and 1917 as well as on those which had been treated with acid phosphate. Six plats therefore were treated with acid phosphate, and three check plats were left untreated. Diagrams of the root-rot areas and counts of the infected plants were made on all plats late in the season. The results in 1918 were corroborative of those obtained in previous seasons, and no beneficial effect of the acid-phosphate treatment in reducing root-rot damage was apparent. The conclusion from the experiments in treating soils with acid phosphate to prevent root-rot during the three years is that such treatment has no effect in preventing root-rot in cotton under the conditions prevailing at San Antonio.

MULCHES.

In 1918 an experiment to test the effect of mulches on cotton root-rot was made. This was a repetition of a similar test made in 1917, the same areas and the same kind of mulches being used. Oat straw and coarse manure were used for mulching. Each mulched area covered two middles between three rows and was of variable length, depending upon the extent of the areas infected with root-rot. The mulches were applied on June 26 and 27. At this time the cotton was 8 or 10 inches high and had not begun to die from root-rot. Observations were made on the mulched areas at frequent intervals throughout the remainder of the season in order to determine whether the mulches had any effect upon the time of appearance of root-rot or upon its extent. It was found that the mulches had no effect upon the spread of the root-rot, the disease being fully as prevalent on the mulched areas as on adjacent land.

EXCAVATIONS.

Work to determine the depth at which root-rot infection takes place was started in 1917. Since cotton does not become affected until late in the season, usually in August, it has been thought that the root-rot infection may gain entrance to the plant through the roots after they descend to a considerable depth. The infected areas on field C5 were used for this study. Six areas, 8 by 16 feet, were selected where the cotton was badly infected with root-rot in 1916. The soil was removed from three of these areas to depths of 18, 32, and 48 inches, respectively, and hauled away from the field. These excavations were then filled in with soil hauled from a field which

had not been cropped for several years and which was assumed to be free from root-rot infection. The soil from the remaining three areas was removed to depths corresponding with the first three, and after lying out for two or three days was returned to the excavation from which it was removed in as nearly as possible the same order as before; that is, each foot section was returned to the depth from which it came. The excavations were made in February, 1917.

It was expected that this would afford an opportunity to determine the depth at which the root-rot infection takes place and also show the effect of aeration on the root-rot fungus. The handling of the soil left it very loose and dry. The subsequent rainfall was insufficient to wet it thoroughly again, and the cotton plants were very small in 1917. No root-rot developed in 1917 on any of the areas where the soil was removed and new soil hauled in, though it occurred all around these spots. Two plants died from root-rot on each of two areas where the same soil was returned to the excavation after aeration. Owing to the small size of the plants on the excavated areas and the shallow rooting of the cotton, it was not considered safe to conclude that the treatment prevented the development of root-rot.

Cotton was again grown in 1918 on the same field, including the excavated areas, and the results shown in Table VIII were noted.

TABLE VIII.—*Results of excavating soil to different depths for the control of cotton root-rot on the San Antonio Experiment Farm in 1918.*

Depth of excavation.	Plants died from root-rot in excavated areas where the soil was—	
	Replaced by new soil.	Aerated and returned.
48 inches	None.	Several.
32 inches	2	Do.
18 inches	3	Do.

These results indicate that the root-rot is in the soil and is removed with the soil. It may be expected, of course, that the fresh soil would eventually become infected with the disease. Cotton will be grown on this area again in 1919 and further observations made.

EXPERIMENTS IN CROP UTILIZATION.

The results of the experiment to determine the value of winter oats and Sudan grass as pasture crops in 1916 and 1917 were encouraging enough to justify a continuation of the experiment in 1918. The two steers which were used in 1916 and 1917 were dis-

posed of at the end of the Sudan grass pasturing period in 1917, and two younger animals were obtained for the continuation of the work.

OATS.

Texas red oats were seeded on 1½ acres of field C3 on October 22, 1917. This land had grown corn in 1917, and the field had been plowed the latter part of August. There was sufficient soil moisture at seeding time for germination, and a good stand was secured. On account of the dry weather which prevailed throughout the fall and winter the oats made a very poor growth and were also injured somewhat by freezing on two occasions.

The spring rains were insufficient to make good growth, and while it appeared that the pasture would be light, it was decided to utilize it for the sake of continuity of the work. The steers used in the experiment were slightly more than a year old and were only of fair quality and breeding. On May 1 they were put into one inclosure of the oat pasture, which had been previously divided into two ¾-acre pastures. The oats were about 8 or 10 inches in height and had begun to head out at the time the pasturing was started.

By June 4 the oats had almost completely dried up. They had dried out so rapidly that much dry straw was left on one of the pastures, while on the other the oats had been closely grazed. On account of the prevailing warm weather it was believed that the oats would make very little more growth, even though the recent rain had moistened the soil to a moderate depth. The steers were therefore removed to the Sudan-grass pasture.

The steers were on the oats pasture for a period of 34 days. The initial weight, as determined from the weighings made on three days at the beginning of the experiment, was 561 pounds for steer No. 1 and 565 pounds for steer No. 2. At the end of the oat-pasturing period the steers were weighed four times—on May 30 and 31 and June 1 and 4. The final weight of steer No. 1, as determined from these four weights, was 666 pounds, and that of steer No. 2, 620 pounds.

The two steers made a total gain of 169 pounds, an average of 85 pounds each, while on the 1½ acres of oats in the 34-day period, being at the rate of 2.5 pounds each per day. Estimating the value of the total gain made at 10 cents per pound, the gains from the 1½ acres were worth $16.90, making the oat pasture worth at the rate of $11.27 per acre. While this is a low return per acre, it is believed that the oats would not have been worth as much for any other purpose, and the cost of harvesting was reduced to a minimum by this method of utilization.

SUDAN GRASS.

Sudan grass was seeded on 2 acres of field C4 on April 12, 1918. This field had grown oats in 1917, was plowed early the preceding fall, and was in good condition at the time of seeding, though it had no large amount of stored soil moisture. A good stand resulted, and the grass grew reasonably well during the early part of the season. On June 4, when the steers were first put on the pasture, the Sudan grass varied in height from 24 to 48 inches. The grass had such a start that the steers were unable to keep it eaten down, even though they were kept on 1 acre of the pasture until June 25. By this date the grass had headed out and was becoming woody, and the steers were removed to the other acre. The grass remaining on the first acre was cut on June 25; also the grass on the east half of the second acre. Cutting was necessary in order to prevent waste and to give the grass an opportunity to put out new growth. The cured Sudan-grass hay from the first acre of the north pasture weighed 2,146 pounds, while that from the east half of the south pasture weighed 2,856 pounds. The grass made slow growth during the latter part of June and July, and by July 29 it had been grazed very closely and had dried up completely. The steers were therefore removed to the dry lot and feeding of Sudan-grass hay was started. The hay fed was that which had been harvested from the pastures early in June.

The steers were kept in the dry lot and fed Sudan-grass hay until August 31, or for a period of 33 days. During that interval a total of 1,624 pounds of hay was fed.

On August 31 the steers were returned to the Sudan-grass pasture. The grass had made very irregular growth and ranged in height from 6 to 18 inches and was heading out. It was thought desirable to graze the grass down before it became overripe and woody. The steers were changed from one pasture to the other as required, and after they had eaten the grass down completely they were again removed to the dry lot on September 16. These steers made very small gains on the pasture during this period, but continued to stay in good flesh. They were fed Sudan-grass hay while in the dry lot, a total of 1,146 pounds being fed in the 21-day period between September 16 and October 7.

On October 7 the steers were again returned to the Sudan-grass pastures. The grass had made some growth as a result of the rains, but the stand was rather thin, a part of the plants having died during the drought. At this time the grass was from 10 to 16 inches in height. The steers were changed from one pasture to the other as was necessary, and on November 13 they were finally removed from the pasture to the dry lot. This completed the pasturing of Sudan grass for the season.

During the period from June 4 to July 29, while the steers were on Sudan-grass pasture, they made a total gain of 191 pounds, an average of 95.5 pounds each, being at the rate of 1.74 pounds each per day. During the second pasturing period, from August 31 to September 16, they made a total gain of 32 pounds, an average of 16 pounds each, or at the rate of 1 pound each day. During the third pasturing period, from October 7 to November 13, they made a total gain of 6 pounds, an average of 3 pounds each, or at the rate of 0.08 pound per day each, which was insignificant. To summarize: The steers were pastured on the 2 acres of Sudan grass a total of 108 days, making a total gain of 229 pounds, an average of 114.5 pounds, or at the rate of 1.06 pounds each per day. Estimating the value of the gains at 10 cents per pound, the pasture was worth at the rate of $11.45 per acre. In addition to the pasture furnished, hay was harvested at the rate of 2,501 pounds per acre.

During the 33 days from July 29 to August 31, while the steers were fed Sudan-grass hay in the dry lot, they made a total gain of 48 pounds, or at the rate of 0.7 pound each per day. During the period of 21 days from September 16 to October 7 the steers made a total gain of 54 pounds, or at the rate of 1.76 pounds each per day. During the total period of 49 days while the steers were fed Sudan-grass hay they made a total gain of 102 pounds, being at the rate of 1.04 pounds each per day. During the entire period the steers were fed Sudan grass hay they consumed a total of 2,770 pounds of hay and gained 102 pounds in weight. Assuming the gains to have been worth 10 cents per pound, or $10.20, the returns from the hay were at the rate of $7.36 per ton.

The adverse conditions of the season, the resultant poor growth made by the oats and the Sudan grass used in this experiment, and the necessity for changing from pasture to dry feed several times during the season made the experiment somewhat unsatisfactory and renders it difficult to determine very definitely the value of the pasturage furnished by the crops. The results of this test and those made in 1916 and 1917 indicate that winter oats make a very satisfactory pasture crop for beef cattle. In all of the tests so far made the animals have gained rapidly when sufficient pasturage was available and have improved greatly in condition while on the pasture. In all instances where the steers were on the oat pasture for any considerable period, they have been in good condition for slaughter when taken off.

The amount of gains made per acre of oat pasture will, of course, vary with the season and the growth of the crop. In the vicinity of San Antonio and southward, the oat crop is not satisfactory for grain and is very little grown as such. The average yield of oats for grain in the rotation experiments for the 9-year period from 1910 to 1918,

inclusive, was 13.1 bushels and for the 3-year period from 1916 to 1918, inclusive, 8.4 bushels per acre. The oat crop is grown in this district chiefly for hay and pasture. The average yield of oat hay in the rotation experiments for the 10-year period from 1909 to 1918, inclusive, was 1.51 tons and for the 3-year period from 1916 to 1918, inclusive, 1.57 tons per acre. The average gain in live weight of beef steers on oat pasture for the 3-year period from 1916 to 1918, inclusive, was 152.1 pounds per acre. It should be kept in mind that the average yields shown above are from different plats on the farm from those which were pastured, and the hay yields on the pastured plats might have been more or less than the average shown. From observations on the growth of the crops, it is thought they would generally have been less. Whether oats can be more profitably utilized for pasture or cut for hay will depend, of course, upon the relative value of beef and hay, upon the difference in cost of harvesting by the two methods, and upon the risk involved. Where the distance from market makes the cost of disposing of the crop in the form of hay excessive, utilizing for pasturage would be indicated.

Steers pastured on Sudan grass do not make as rapid or consistent gains as when on winter oats. This may be due to difference in feeding value or other conditions. It is likely that the weather conditions and the effect of flies had an important influence upon the difference in value of the two crops for pasture, inasmuch as hot weather prevailed while the steers were on Sudan grass and cool weather while on oat pasture. From the results obtained, it appears that the utilization of Sudan grass for pasture is questionable, especially under the conditions prevailing at San Antonio as to hay prices. With lower hay prices and long distances from markets, the use of Sudan grass for pasture might be desirable. Under actual farm or ranch conditions it is thought that the first crop of Sudan grass might be harvested and the subsequent growth utilized for pasturage. On most farms where many live stock are kept, some native pasture is usually available early in the season. This would be when the first crop of Sudan grass is growing. A shortage of range is most likely to occur during the late summer, and the utilization of the second growth of Sudan-grass fields for grazing might be very desirable under such conditions.

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